

WHAT IS CLAIMED IS:

1. A method for producing an electron-emitting device, comprising the steps of:

(A) disposing a cathode electrode on a surface of a substrate;

(B) providing an electrode opposite the cathode electrode;

(C) disposing plural pieces of fiber containing carbon as a main component on the cathode electrode; and

(D) applying potential higher than potential applied to the cathode electrode under depressurized condition to an electrode opposite the cathode electrode.

2. The method for producing an electron-emitting device, according to claim 1, wherein

said electrode opposite the cathode electrode is an anode electrode provided apart the substrate.

3. The method for producing an electron-emitting device, according to claim 1, wherein

said electrode opposite the cathode electrode is a leading electrode provided apart from the cathode electrode on the surface of the substrate.

4. The method for producing an electron-emitting

device, according to claim 1, wherein

said step of applying potential to the electrode opposite the cathode electrode is a step of increasing the number of emission sites.

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5. The method for producing an electron-emitting device, according to claim 1, wherein

10 said potential applied to the electrode opposite the cathode electrode is potential at which an electron is emitted from the fiber.

6. The method for producing an electron-emitting device, according to claim 1, wherein

15 said step of applying the potential to the electrode opposite the cathode electrode is performed under condition of a gas chemically or physically reactive to the fiber.

20 7. The method for producing an electron-emitting device, according to claim 6, wherein

said gas chemically reactive to the fiber is one of O₂, H₂, CO₂, and H₂O.

25 8. The method for producing an electron-emitting device, according to claim 6, wherein

a pressure for introducing the gas is equal to or over 1×10^{-4} Pa.

9. The method for producing an electron-emitting device, according to claim 6, wherein

5 said step of applying the potential to the electrode opposite the cathode electrode is a step of applying a pulse voltage between the cathode electrode and the electrode opposite the cathode electrode.

10. The method for producing an electron-emitting device, according to claim 1, wherein

10 said fiber is formed by decomposing a hydrogen carbide gas.

11. The method for producing an electron-emitting device, according to claim 10, wherein

15 said fiber is formed by decomposing the hydrogen carbide gas using a catalyst provided on the cathode electrode in advance.

12. The method for producing an electron-emitting device, according to claim 11, wherein

said catalyst is one of Fe, Co, Pd, and Ni, or an alloy consisting of materials selected from among Fe, Co, Pd, and Ni.

25 13. The method for producing an electron-emitting device, according to claim 1, wherein

said fiber is formed by graphite nanofiber, carbon

nanotube, or amorphous carbon fiber.

14. The method for producing an electron-emitting device, according to claim 1, wherein

5 said fiber comprises a graphen.

15. The method for producing an electron-emitting device, according to claim 1, wherein

10 said fiber comprises a plurality of graphens.

16. The method for producing an electron-emitting device, according to claim 15, wherein

15 said plurality of graphens are layered in an axial direction of the fiber.

17. A method for producing an electron source obtained by arranging a plurality of electron-emitting devices, which are produced according to any of claims 1 to 16.

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18. A method for producing an image-forming apparatus having an electron source and an image-forming member, wherein

25 said electron source is produced in the method according to claim 17.

19. A method for producing an electron source

having a plurality of electron-emitting devices,
comprising the steps of:

(A) providing on a substrate a plurality of
electron-emitting devices comprising plural pieces of
5 fiber each containing carbon as a main component, and
plural pieces of wiring electrically connected to at
least one of the plurality of electron-emitting
devices;

(B) measuring by applying a voltage to at least a
10 part of the plurality of electron-emitting devices, an
electrical characteristic of said at least a part of
the plurality of electron-emitting devices to which the
voltage is applied;

(C) reducing a difference in electrical
15 characteristic among the plurality of electron-emitting
devices based on a measurement result, wherein

said step of reducing the difference in
characteristic among the plurality of electron-emitting
devices comprising a step of emitting an electron from
20 at least one of the plurality of electron-emitting
devices under depressurized condition.

20. The method for producing an electron source,
according to claim 19, wherein

25 said plural pieces of wiring comprises plural
pieces of row direction wiring, and plural pieces of
column direction wiring crossing the row direction

wiring, and each of the electron-emitting devices is connected to one of the row direction wiring and one of the column direction wiring.

5 21. The method for producing an electron source, according to claim 20, wherein

 said step of reducing the difference in
characteristic among the plurality of electron-emitting
10 devices contains a step of emitting an electron from a
desired electron-emitting device by repeating a step of
selecting from said plural pieces of column direction
wiring or said plural piece of row direction wiring, a
part of the pieces of column direction wiring or row
direction wiring, and emitting an electron from an
15 electron-emitting device connected to the selected
wiring.

 22. The method for producing an electron source, according to claim 19, wherein

20 said step of reducing the difference in
characteristic among the plurality of electron-emitting
devices contains a step of emitting an electron from a
desired electron-emitting device by repeating a step of
selecting a part of electron-emitting devices from
25 among the plurality of electron-emitting devices and
emitting an electron from the selected electron-
emitting device.

23. The method for producing an electron source,
according to claim 19, wherein:

5 said electron-emitting device contains a cathode
electrode to which the fiber is electrically connected,
and a leading electrode provided apart from the cathode
electrode; and

10 said step of emitting an electron from the
electron-emitting device is performed by applying a
voltage between the cathode electrode and the leading
electrode.

24. The method for producing an electron source,
according to claim 19, wherein

15 said step of emitting an electron from the
electron-emitting device is performed by applying a
voltage between the electrode provided apart from the
substrate and the electron-emitting device.

20 25. The method for producing an electron source,
according to claim 19, wherein:

 said electron-emitting device contains a cathode
electrode to which the fiber is electrically connected,
and a leading electrode provided apart from the cathode
electrode; and

25 said step of emitting an electron from the
electron-emitting device is performed by applying a
potential difference between an electrode provided

apart from the substrate and the electron-emitting device.

26. The method for producing an electron source,
5 according to claim 19, wherein

said step of reducing the difference in
characteristic among the plurality of electron-emitting
devices is a step of increasing the number of emission
sites of at least one electron-emitting device.

27. The method for producing an electron source,
according to claim 19, wherein

said step of reducing the difference in
characteristic among the plurality of electron-emitting
15 devices is performed in ambient of a gas chemically or
physically reactive to the fiber.

28. The method for producing an electron source,
according to claim 27, wherein

20 said gas chemically reactive to the fiber contains
a gas selected at least from among O₂, H₂, CO₂, and H₂O.

29. The method for producing an electron source,
according to claim 28, wherein

25 a pressure for introducing the gas is equal to or
over 1×10^{-4} Pa.

30. The method for producing an electron source,
according to claim 27, wherein

5 said step of emitting an electron from the
electron-emitting device is performed by applying a
pulse voltage to the electron-emitting device.

31. The method for producing an electron source,
according to claim 19, wherein

10 said fiber is formed by decomposing a hydrogen
carbide gas.

32. The method for producing an electron-emitting
device, according to claim 31, wherein

15 said fiber is formed by decomposing the hydrogen
carbide gas using a catalyst provided on the cathode
electrode in advance.

33. The method for producing an electron-emitting
device, according to claim 32, wherein

20 said catalyst is one of Fe, Co, Pd, and Ni, or an
alloy consisting of materials selected from among Fe,
Co, Pd, and Ni.

25 34. The method for producing an electron-emitting
device, according to claim 19, wherein

said fiber is formed by graphite nanofiber, carbon
nanotube, or amorphous carbon fiber.

35. The method for producing an electron-emitting device, according to claim 19, wherein
said fiber comprises a graphen.

5 36. The method for producing an electron-emitting device, according to claim 19, wherein
said fiber comprises a plurality of graphens.

10 37. An electron-emitting device according to claim 36, wherein
said plurality of graphens are layered in an axial direction of the fiber containing carbon as a main component.

15 38. A method for producing an image-forming apparatus having an electron source and an electron-emitting member, wherein
said electron source is produced in the method according to any of claims 19 to 37.

20 39. The method for producing an image-forming apparatus, according to claim 38, wherein
said image-forming apparatus is obtained by seal bonding a first substrate provided with the image-forming member with a second substrate provided with the electron source; and an electrical characteristic of the electron-emitting device is measured before the

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first and second substrates are seal bonded with each other.

40. The method for producing an image-forming
5 apparatus, according to claim 38, wherein

10 said image-forming apparatus is obtained by seal bonding a first substrate provided with the image-forming member with a second substrate provided with the electron source; and said step of reducing the difference in electrical characteristic among the plurality of electron-emitting devices is performed before the first and second substrates are seal bonded with each other.